

Towards Establishing NARCCAP Regional Model Credibility Through Process-Based Analysis

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NCAR/IMAGE

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Introduction

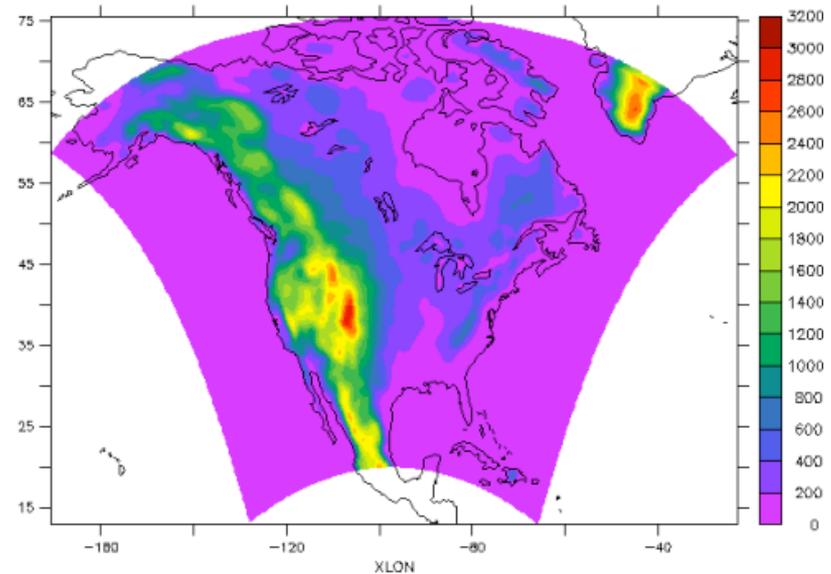


- Examine credibility of an ensemble of RCM simulations and their projections for warm-season precipitation over the Southwest*, Central U.S., and Northeast U.S.
- Establish the differential credibility of the RCM/GCM combinations.
- Extend analysis beyond temperature and precipitation and the use of basic metrics.
 - Establish whether or not the *processes* responsible for the precipitation are credibly simulated.
- Identify bias in related processes and establish the potential impact of that bias on projections.



North American Regional Climate Change Assessment Program

- 6 RCMs downscaling 4 GCMs (with 12 combinations planned)
 - Current: 1971-2000 (1999)
 - Future: 2041-2070 (2069)
- RCMs are also being used to dynamically downscale the NCEP/DOE Reanalysis 2
 - 1980-2004
- 50-km horizontal resolution over most of North America
- Plus, 2 global 50-km timeslices (GFDL and CAM).

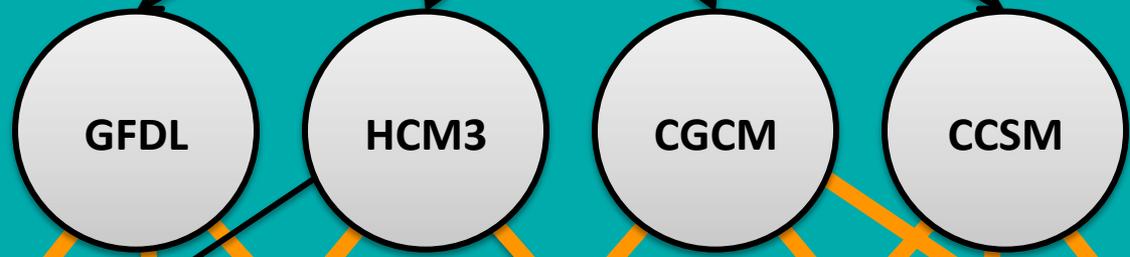


Emissions Scenario

Phase 2



GCM

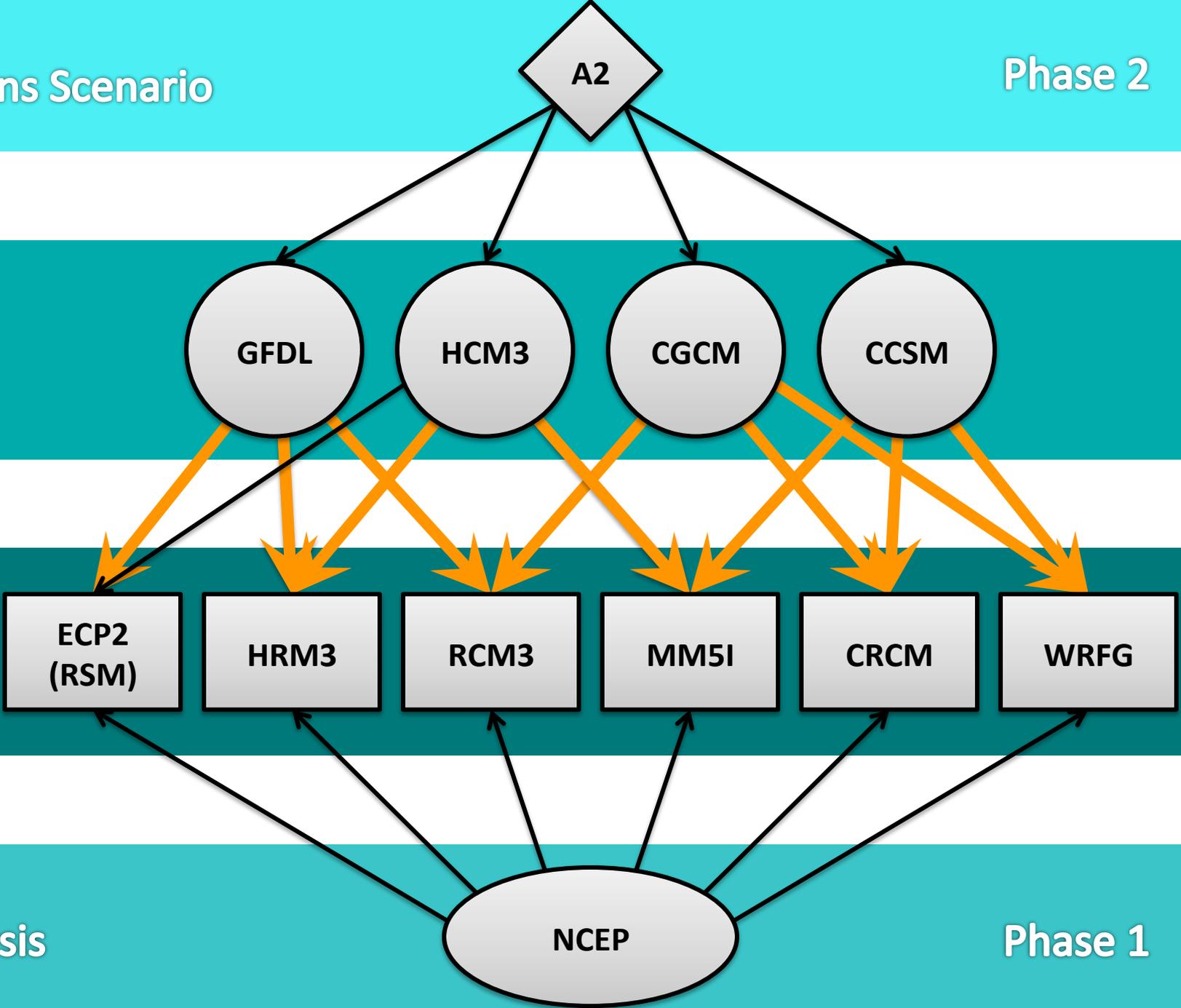


RCM



Reanalysis

Phase 1

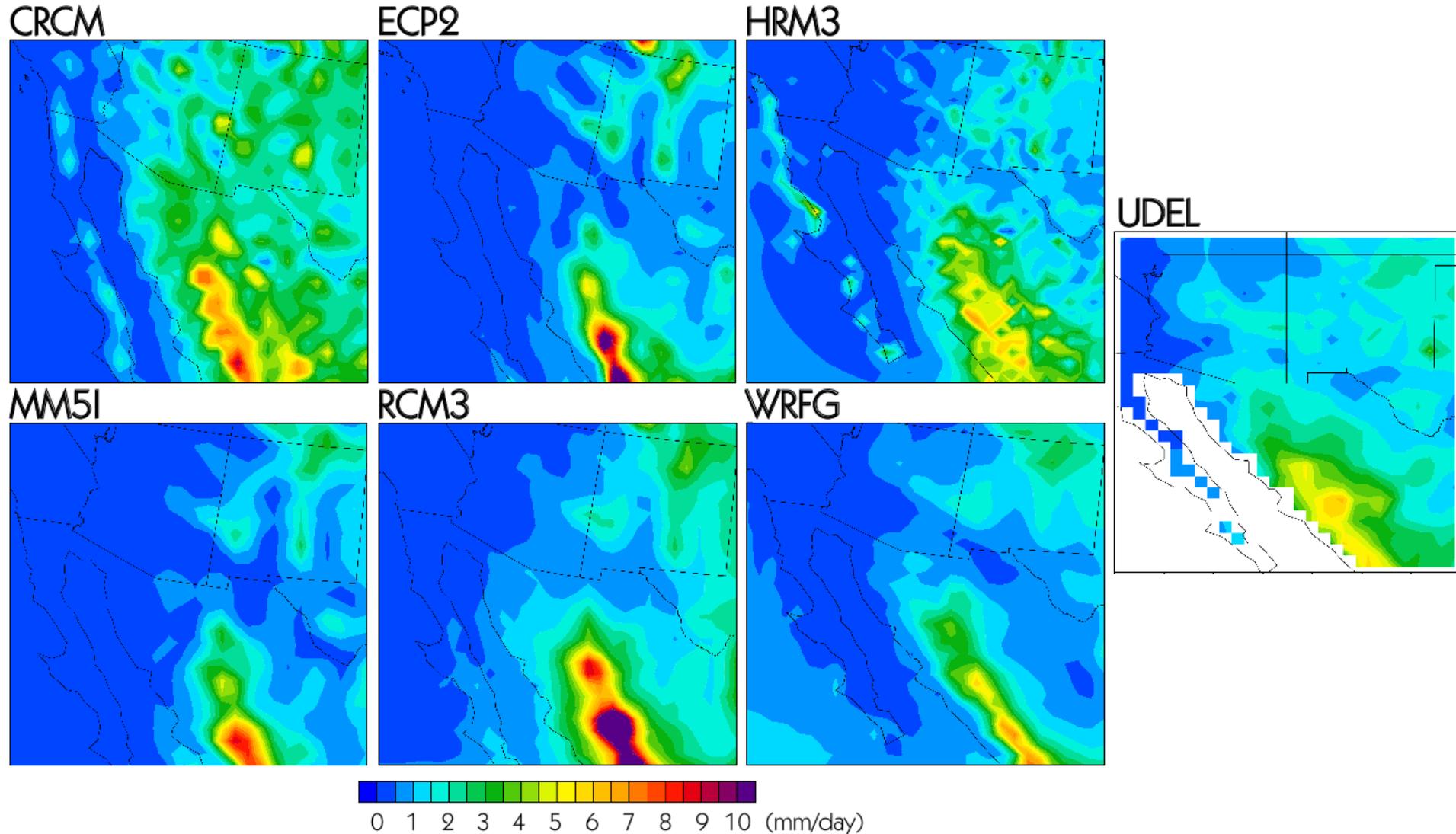


Other Datasets



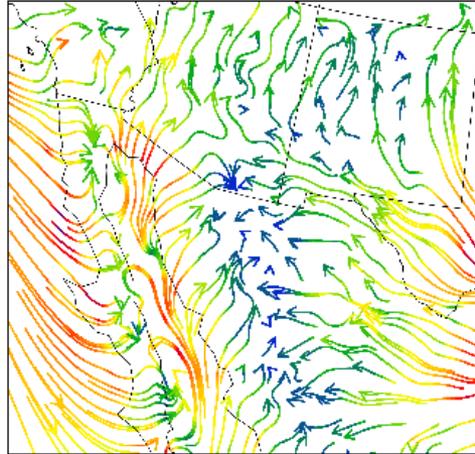
- CMIP3 and CMIP5 AOGCMs
- For comparison:
 - **NARR** (North American Regional Reanalysis), **32-km** horizontal resolution.
 - **UDEL** (University of Delaware), **½ degree** resolution, gridded observations, for land only.
 - **NAME** (North American Monsoon Experiment), **1 degree** resolution, gridded observations from a special observing period during July 2004
 - **TRMM** (Tropical Rainfall Measuring Mission) satellite derived precipitation. **¼ degree** resolution, available Dec. 1997 – present.
 - **20th Century Reanalysis**. **2 degree** horizontal resolution, 1871-2012.

1980-2004 JJAS Average Precipitation Rate: NCEP-driven

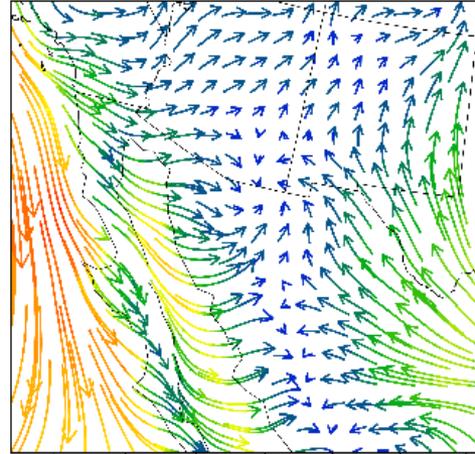


1980-2004 JJAS Average Near-Surface Moisture Flux: NCEP-driven Simulations

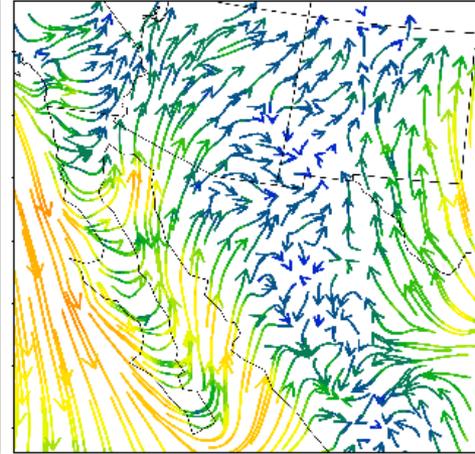
CRCM



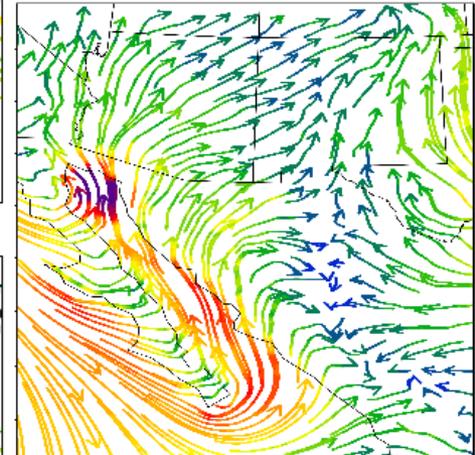
ECP2



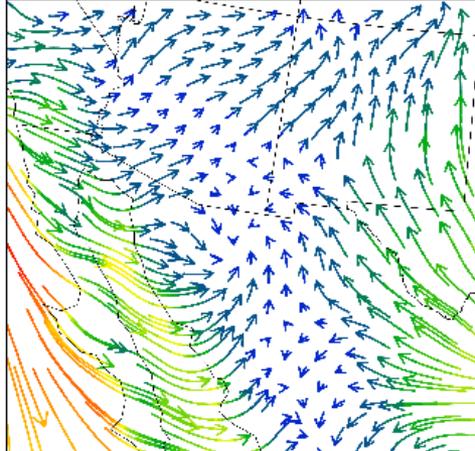
HRM3



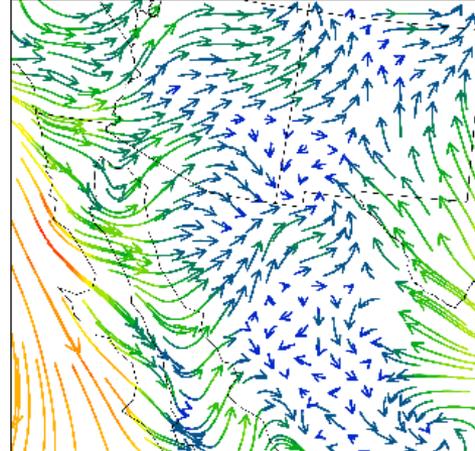
NARR



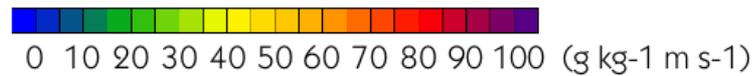
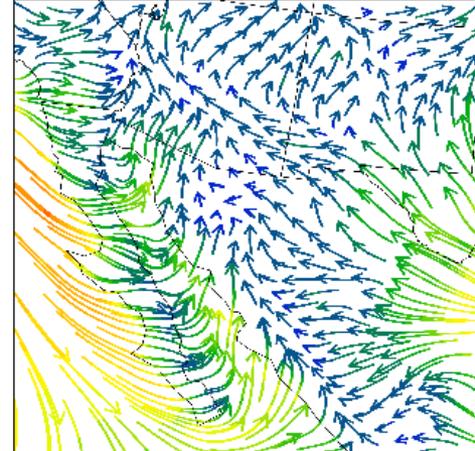
MM5I



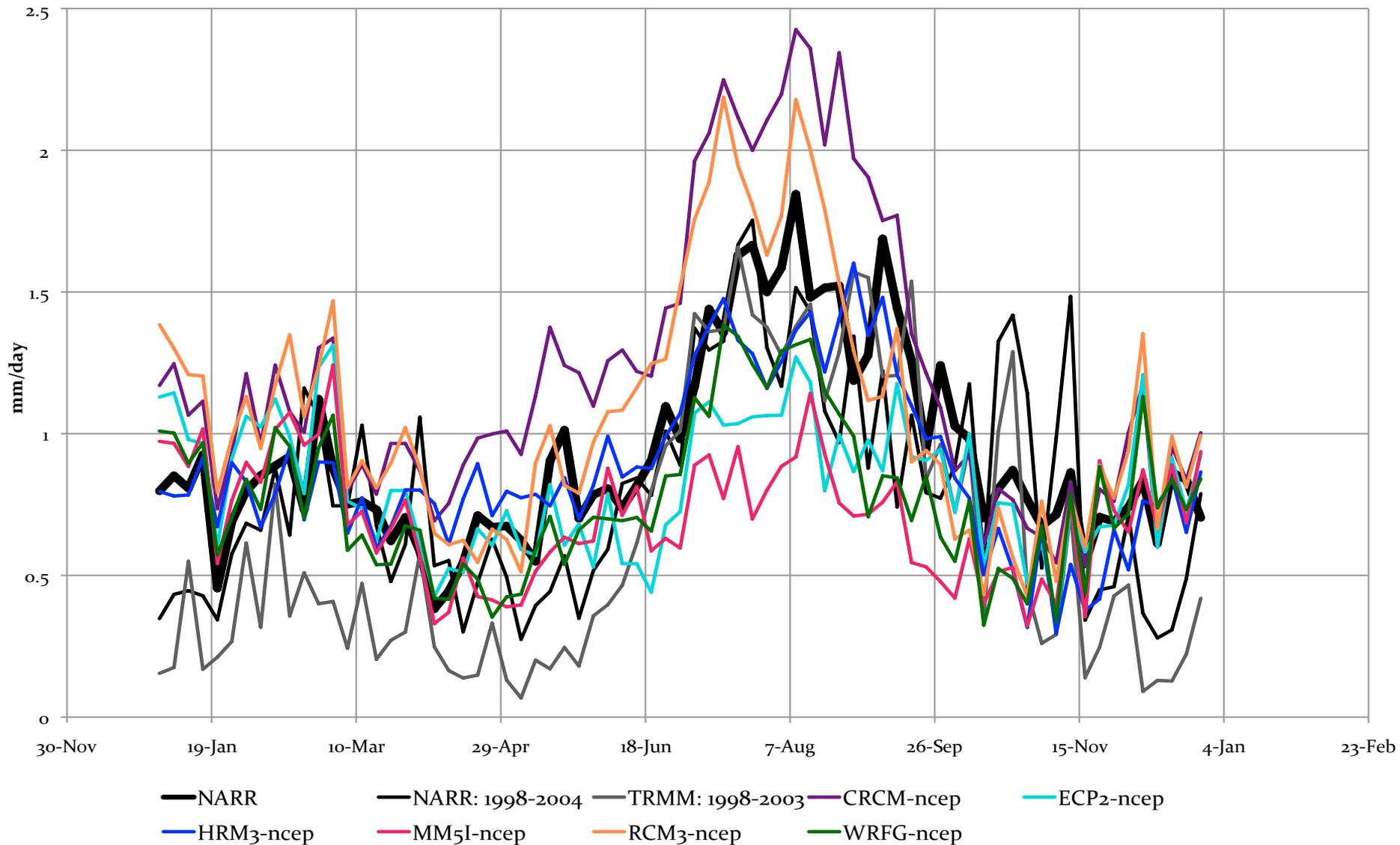
RCM3



WRFG

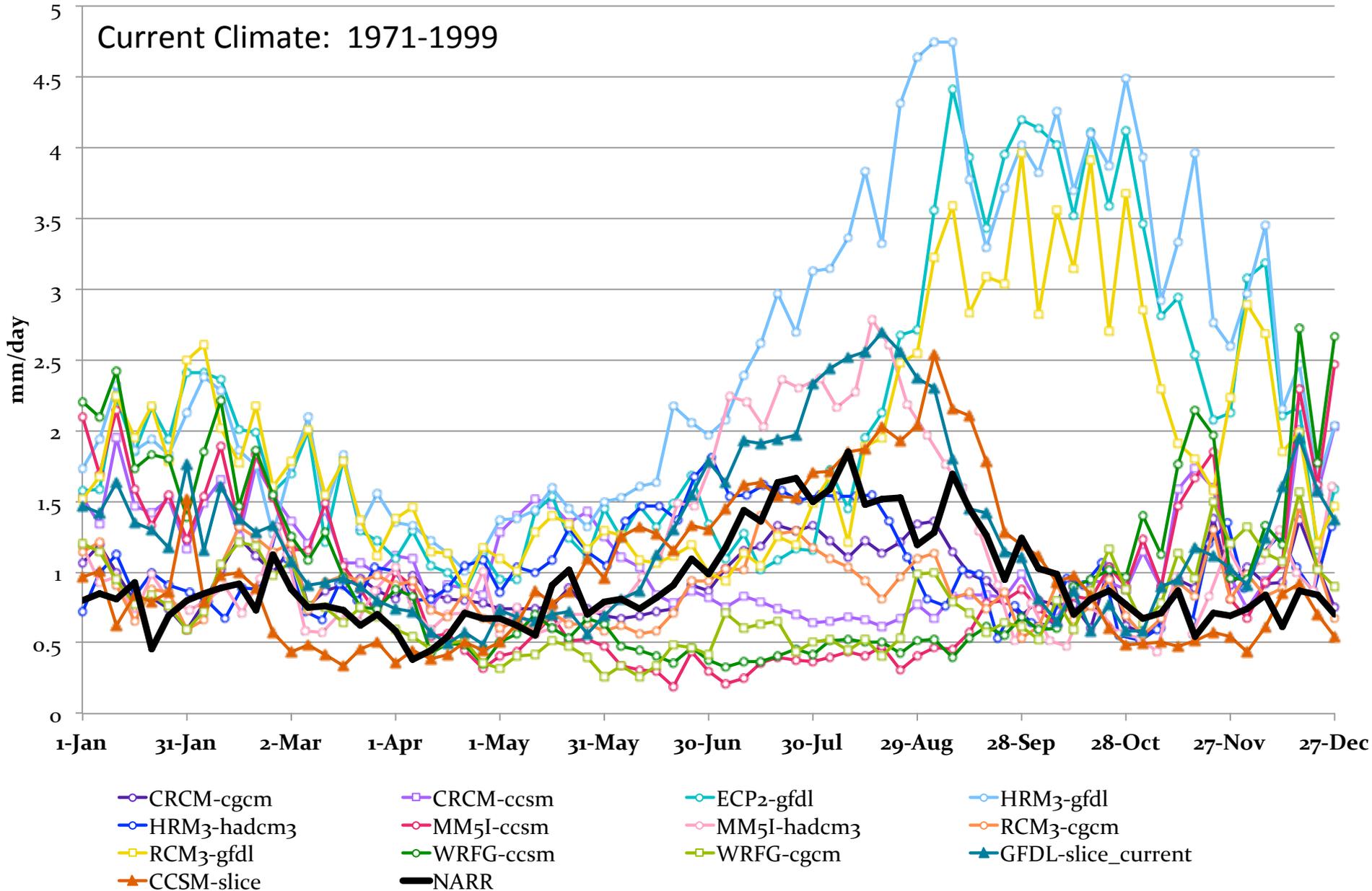


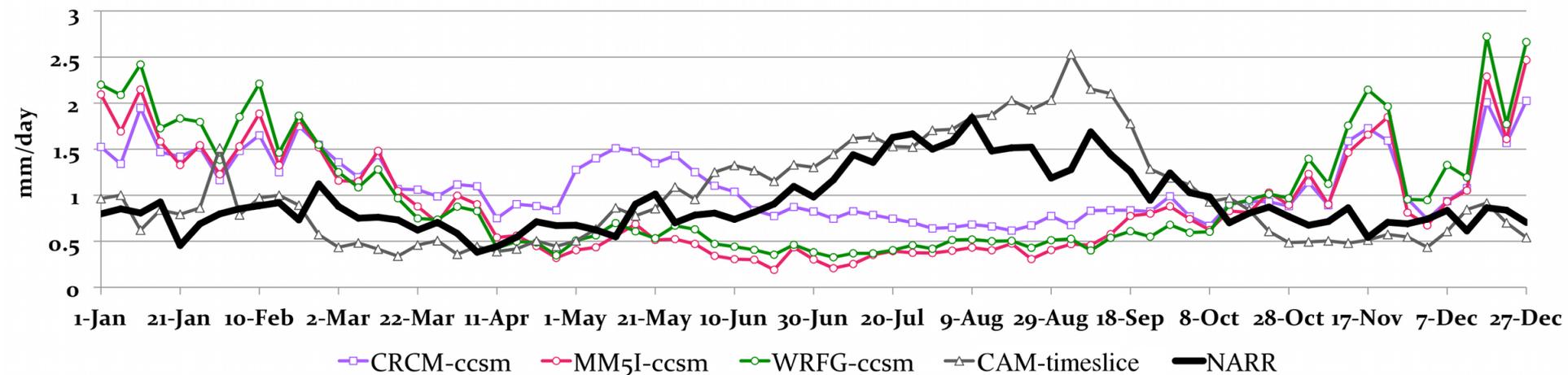
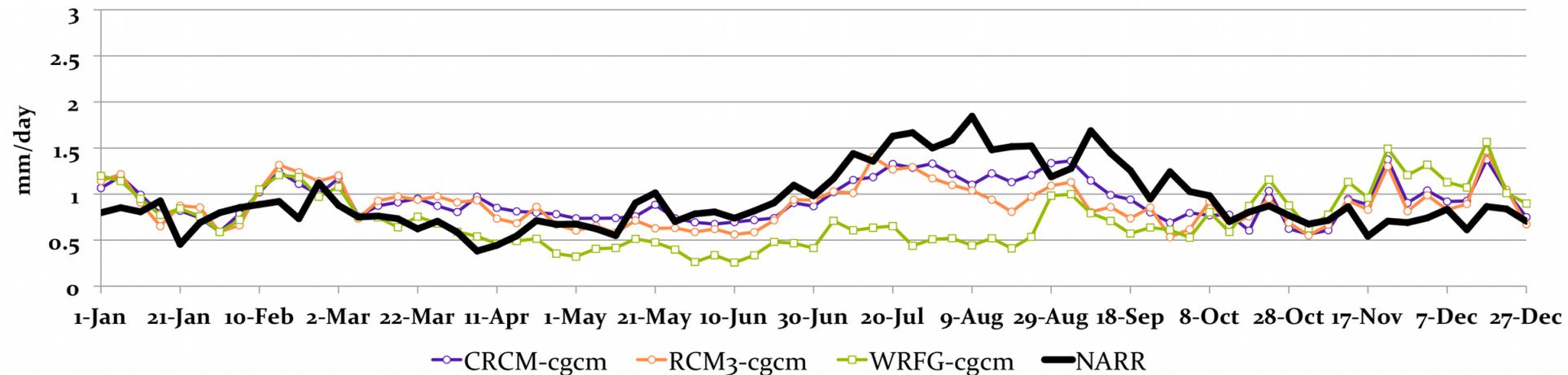
1980-2004 5-day Average Precipitation Climatology NCEP-Driven Simulations



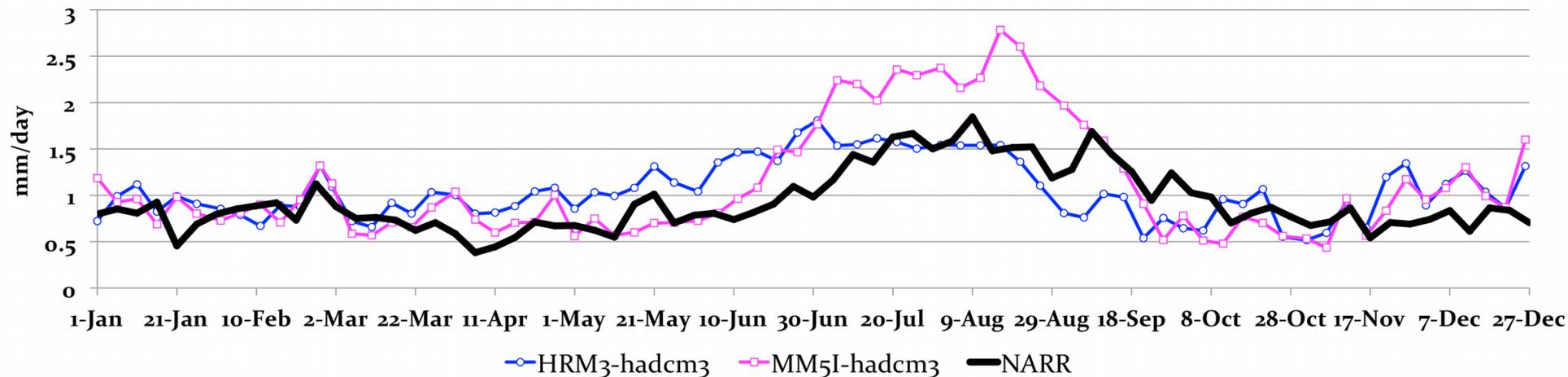
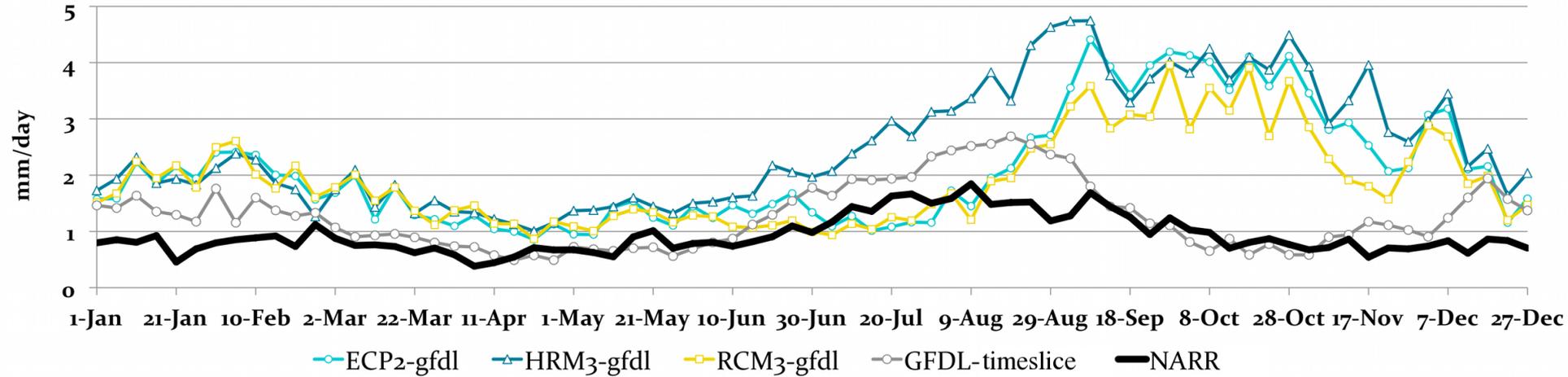
GCM-driven 5-day Average Precipitation Climatology

Current Climate: 1971-1999

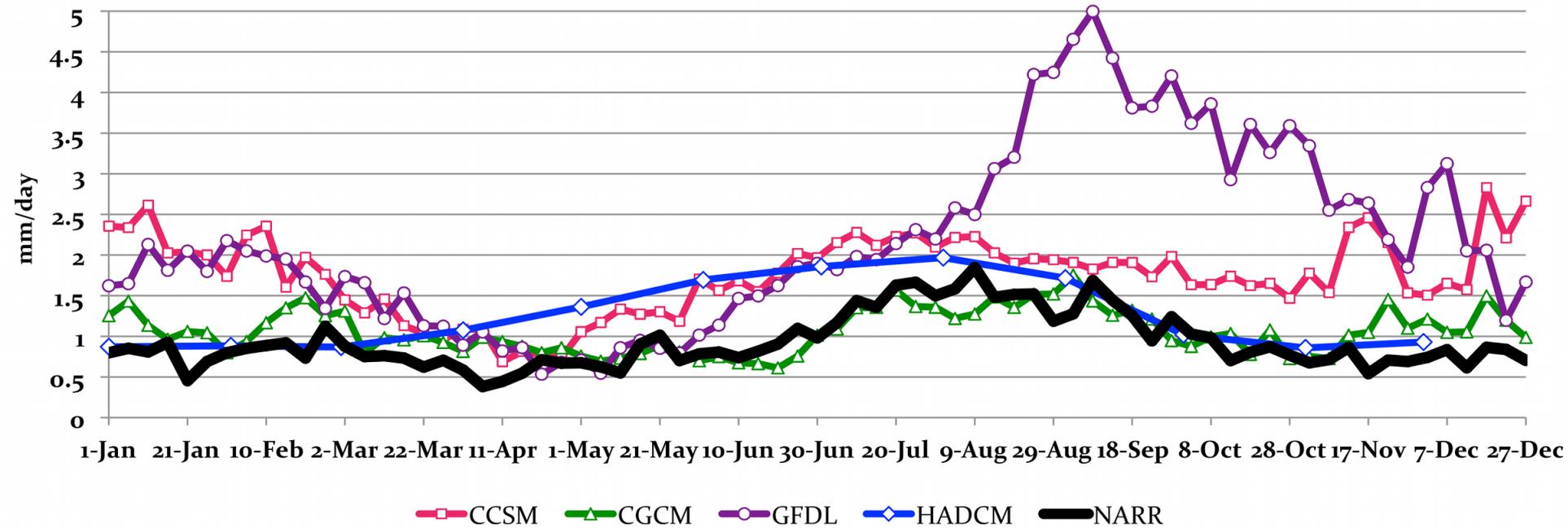




5-day Average Precipitation Climatology



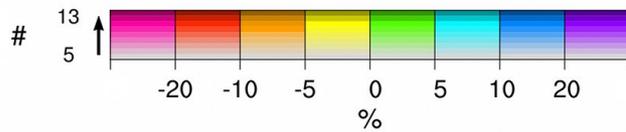
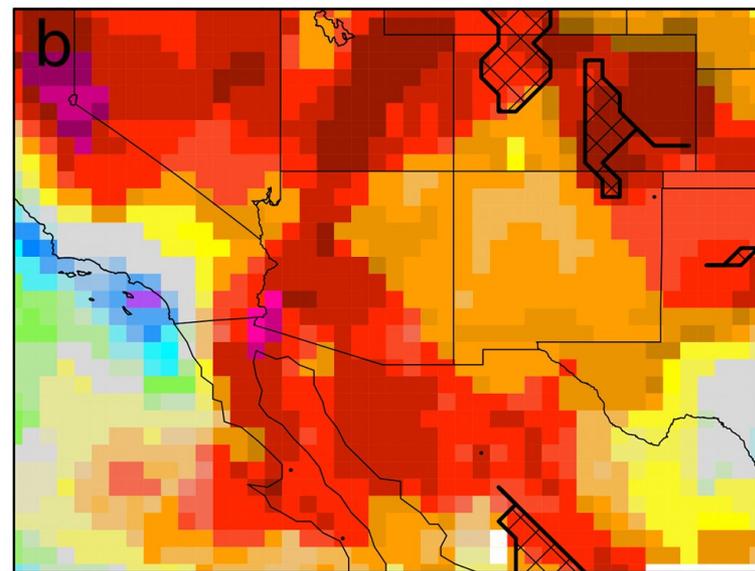
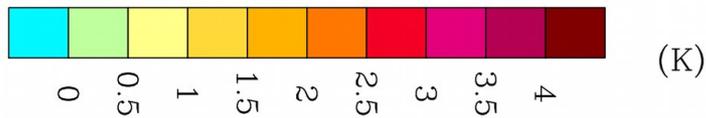
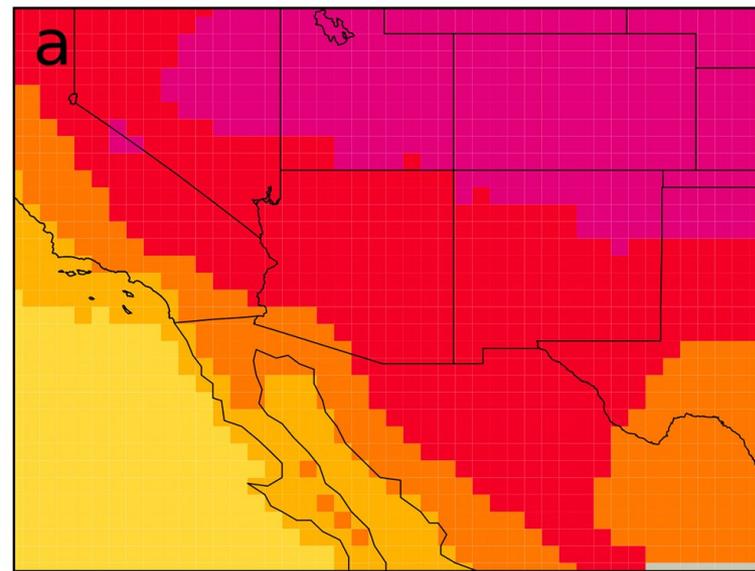
5-day Average Precipitation Climatology



5-day or Monthly Average GCM Precipitation Climatology

JJAS NARCCAP 13- Model Ensemble Mean Change

- a) 2-m Temperature
- b) Precipitation



In b) : Vertical color scale indicates model agreement on the sign of change. Hatching indicates where more than 50% of the models show change that is significant at the 0.10 level *and* where more than 75% of the models agree on the sign of change.

NAM Region	% Change	Absolute Change (mm/day)
Ensemble Average	-15.10	-0.13
CCSM-driven	-28.20	-0.15
CGCM-driven	-25.89	-0.22
GFDL-driven	-4.28	-0.09
HADCM-driven	-0.05	0.01

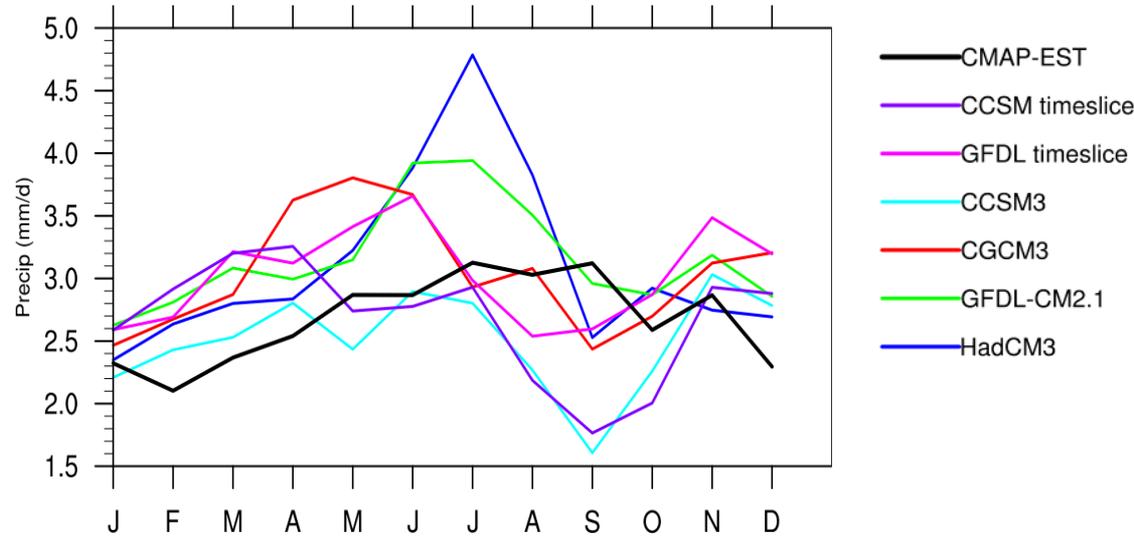
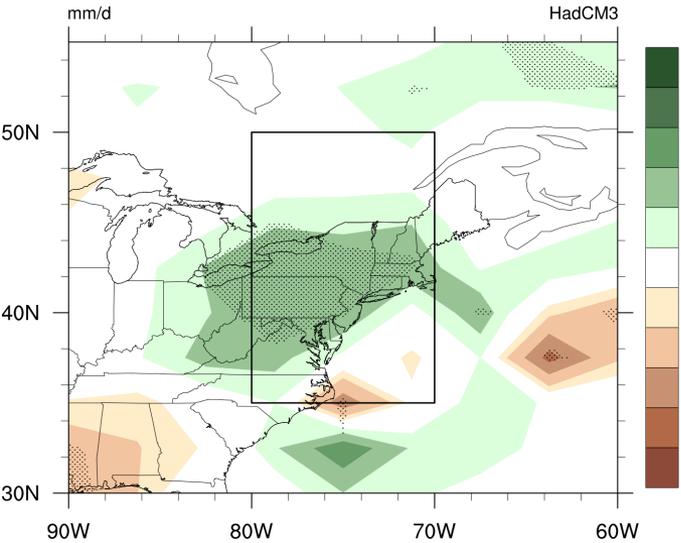
Impact of Bias on Precipitation Change

Left: mean change

Below: change in frequency of 3-hourly precipitation events by percentile.



A Brief Example for the Northeast

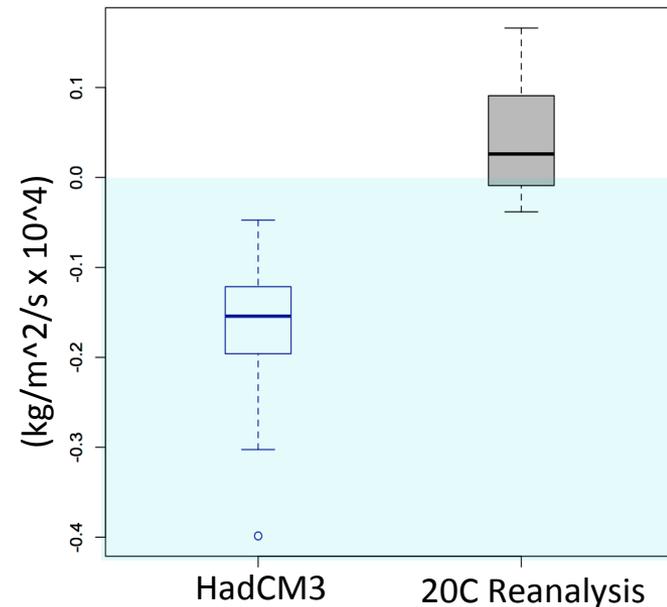


Top Left: 1981-2000 to 2051-2070 JJA precipitation change (mm/day) from the HADCM3.

Top Right: 1981-2000 monthly average precipitation for the Northeast (inset box to left).

Bottom Right: 1981-2000 JJA interannual variability of vertically integrated moisture flux divergence.

RCM simulations driven by the HADCM3 may inherit similar errors.



Final Comments

- Work in Progress!
 - More to come on the processes driving changes in the Southwest, model credibility in the Northeast, and the start of the analysis in the Central U.S.
- The ability of the models to capture monsoon system rainfall is heavily determined by driving GCM. Whether or not this applies in the Northeast is still under investigation.
 - Good argument for continued improvement of AOGCMs!
- Projections for precipitation change in the Southwest are influenced by model bias, with the largest negative changes in the simulations with the poorest verifications.

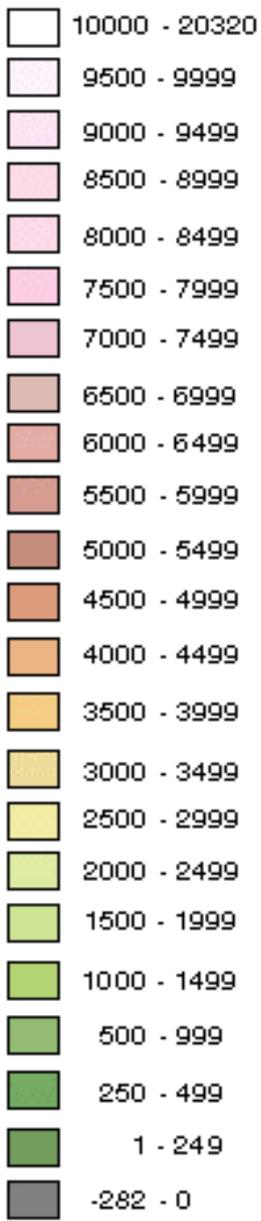


Shaded Relief - Land and Ocean
 Source: [U.S. Geological Survey](#)

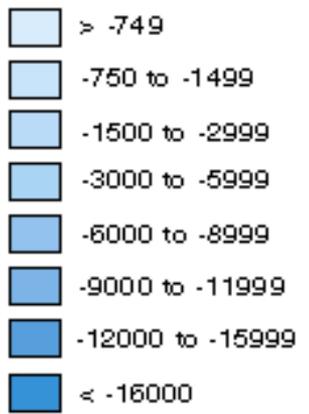


Shaded Relief - Land and Ocean

Elevation in Feet



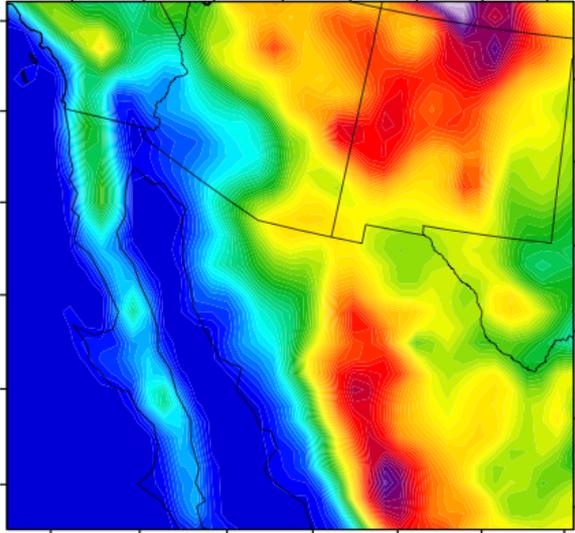
Bathymetry in Feet



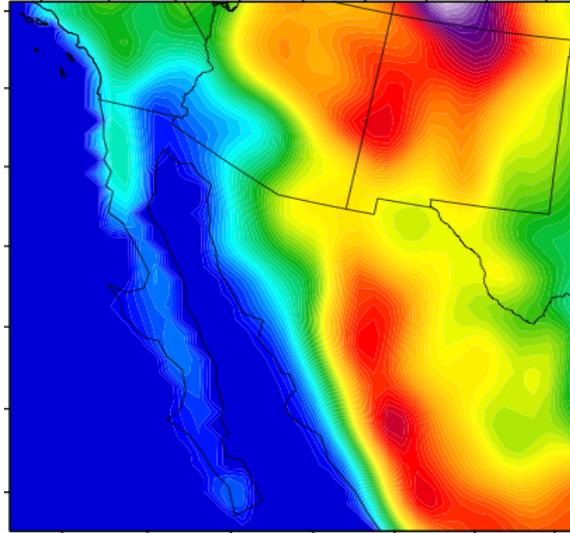
Bathymetric intervals only apply to ocean bodies

RCM Terrain

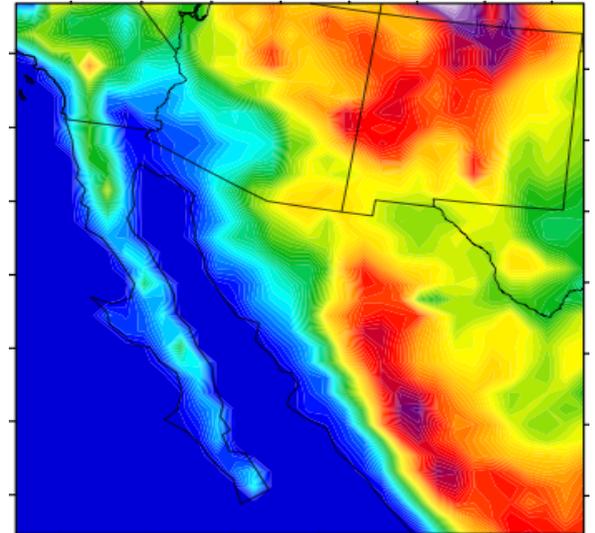
CRCM



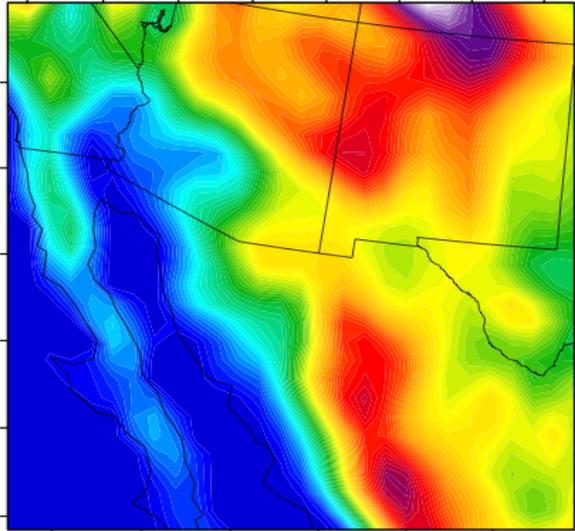
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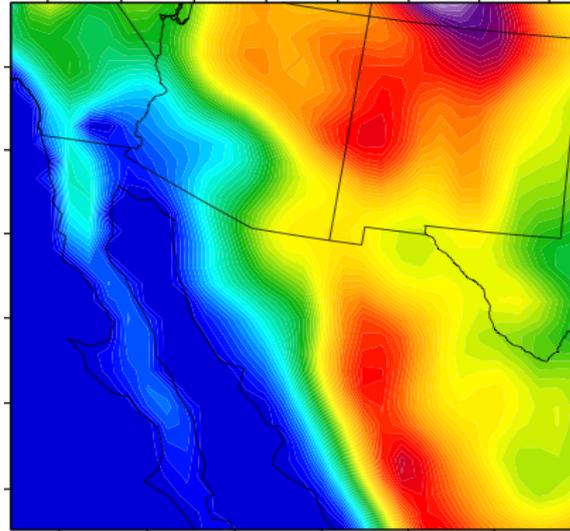
HRM3



MM5I



RCM3



WRFG

